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Part 1.

REVISION OF THE LIOTIIDAE OF NEW SOUTH WALES.

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(Figures 1-49.)

INTRODUCTION.

The original intention of this paper was to review the family of the Liotiidae alone, but it has been extended to include a number of other species, the classification of some of which is uncertain. The exact limitations of the Liotiidae are not yet well defined. The minute size of many species, and the fact that when living material is obtained specimens are only procured when this has been dried out, makes the study of the animal and even the operculum very difficult. The Orbitestellidae have been recognised as a different family, and many authors use Cyclostremidae as another distinct group. Apart from these there are other groups whose systematic position can only be guessed, and ultimately it will probably be found that the complete classification is very complex. An immediate necessity, however, is to catalogue and figure such species as exist on the coast, as a preliminary for the deeper study of phylogeny and ecology.

Even in taxonomy comparatively little has been done in New South Wales. Charles Hedley in his Check List allowed 24 species under Liotiidae and one *Orbitestella*. Of these, seven species described by Hedley himself have been excellently described and figured and their future recognition presents no difficulty. Species named by Angas are also satisfactory, as is Brazier's *Liotella pulcherrima*. Of the others, most are Tasmanian and Southern Australian species, whose extended range to New South Wales is often open to considerable doubt. This applies particularly to the several species proposed by the Rev. J. E. Tenison Woods. It is unfortunate that these were invariably unfigured, the descriptions were entirely inadequate, confined to a few lines of Latin with omission of many essential characters, and without access to the types recognition is almost impossible. This has led to much confusion. For instance, Professor Tate and W. L. May have identified and figured two different species as *Liotella annulata* Ten. Woods, one from South Australia, the other from Tasmania, while that recorded as *annulata* from New South Wales, while resembling the Tasmanian form, seems different from either.

Tasmanian species which appear on the New South Wales list were mostly identified by Hedley from deep sea dredgings by the "Thetis" and other expeditions. Even these cannot be taken as certain. The shells are so minute, that unless a species is a striking novelty, a general resemblance has been sufficient to cause workers to extend the range from one State to another. When every species, known or unknown, is drawn, differences in detail are revealed, showing that many are quite different from those with which they have been identified, and others, though tentatively retained under their former names, may yet prove to be distinct species.

Of the other species described in this paper, some show relationship with Queensland species, themselves as yet undescribed. The field here is enormous. Practically the only work done in Queensland on minute shells is that by the late Charles Hedley, and that mainly from two localities only—the Hope Islands and Masthead Island. There are literally hundreds of species, more or less related to the Liotiidae, which are as yet entirely unstudied, the great majority of which need new specific and in many cases new generic names. It is hoped that this attempt to systematise the group in New South Wales, practically synonymous with the Peronian Zoogeographical Province, will stimulate the desire to do likewise in Northern Australian waters.

Practically all the material in this paper has been collected by my son John and myself in the last twenty years. I am deeply indebted to Mr. Tom Iredale, who throughout has taken the greatest interest in the work, has ever been ready with useful advice, and who has given freely of his own great knowledge and experience. All the types, as well as specimens illustrated, are being presented to the Australian Museum, where they will be kept as a separate unit and thus be available for future reference.

As in my other papers, the reference Hedley 466, or May 365, denotes the number indicating a species in the papers by Charles Hedley and W. L. May, respectively: "A Check List of the Marine Fauna of New South Wales, Part I," Supplement to Jour. Roy. Soc., N.S.W., Vol. LI, 1917, and "A Check List of the Mollusca of Tasmania," Govt. Printer, Hobart, 1921 and 1923.

Family LIOTIIDAE.

Genus LIOTINA, Fischer, 1885.

Liotina, Fisher, Man, de Conch. 1885, p. 831. Type, *L. gervillei* Defr. (Eocene fossil, Europe).

Liotina botanica Hedley. Figures 1, 1a.

Hedley 466.

This is the largest and also the commonest of the New South Wales species. It has been excellently described and figured by Hedley, and there is little to be added to his description. It is common on beaches right along the coast, and we have found it alive under rocks in pools at Long Reef, north of Sydney. The specimen figured is from this locality, and its major diameter is 6.5 mm., comparing with 7 mm. in the type. As the operculum has not yet been described, the opportunity is taken to note the following characters. It is circular with a central depressed nucleus, multi-spiral, the spirals very numerous and close together, and covered with minute raised tubercles. It is thick, with an outer, thin translucent and apparently horny layer both on the external and internal surfaces, between which is a thick, granular (? crystalline) layer.

It is a very constant species, easily recognised by its form, sculpture and prominent varix surrounding the aperture, and there is no other species with which it can readily be confused.

Liotina saxa, sp. nov. Figures 2, 2a.

Shell large for the group, massive, depressed turbate, yellowish. Protoconch small and naticoid in a flat summit. Whorls 4, increasing rapidly, angular at the periphery, flattened above, sutures deep. The sculpture consists primarily of a strong concentric keel at the periphery, a lesser keel below this, another fainter keel below this and a fourth keel on the base. There are also two faint keels above, between the shoulder of the whorl and the suture. The transverse sculpture consists of broad, rounded costae, fading on the base, about 12 on the body whorl, and rising into prominent protuberances where they cross the keels. Secondary transverse sculpture consists of very fine, sharp, closely-packed ridges, covering both the main costae and the spaces between, and continuous from the suture downwards across the base and on to the walls of the umbilicus. Aperture rounded and entire, oblique, its margin broadened by a thick varix. Umbilicus large and deep, the funicle and sides with sharp vertical ridges. Height 5 mm., maximum diameter 7 mm., minimum diameter 5.5 mm.

Locality:—14 fathoms off Long Reef (type); also 2 specimens 30-35 fathoms off Crookhaven.

Remarks:—The nearest relation of this species seems to be *L. densilineata* Tate, but it differs in details of the sculpture and in the umbilicus.

Liotina scalaris Hedley.

Hedley 467.

Originally recorded as *Liotia tasmanica* Ten. Woods, var. *scalaris* Hedley, this is a deep water species from the continental shelf. I have not seen specimens, but from a figure published by T. Iredale, 1936, it has a higher spire and is much more rugose than *L. saxa*, though the general features of the sculpture are similar.

Genus PSEUDOLIOTIA Tate.

Trans. Royal Soc. S. Aust., xxii., 1898, p. 71.

Genotype *Liotia micans* Adams.

Tate's description of *Pseudoliotia* is as follows: "Shell something like *Liotia*, shell thick and porcellaneous, aperture oblique, operculum horny and multispiral. Recalls *Molleria*, which is differentiated by a calcareous operculum."

Various authors, including Iredale, Hedley and May, have since regarded *Pseudoliotia* as a synonym of *Liotia*, but the Australian species usually regarded as true *Liotias* are tropical forms, larger and with more elevated spires. *Pseudoliotia* forms apparently a natural group, of which two species occur in southern Australia, and similar, if not exactly the same, species in Queensland and northern Australia as far as Darwin. Tate's genus may therefore be left until further data determine its exact systematic position.

Pseudoliotia micans Adams. Figures 3, 3a.*Pseudoliotia speciosa* Angas. Figures 4, 4a.

Hedley 464.

Though these are two distinct species, they are better discussed together, as there has been some confusion about their identity, and Hedley in his Check List synonymizes *speciosa* under *micans*. Both seem to have a wide geographical range; just how wide is not yet correctly known. The type locality of *micans* is South Australia, and both the Tasmanian and New South Wales specimens cannot be distinguished from those from South Australia. *P. speciosa* was described from Sydney Harbour, and extends northwards. Two similar if not identical species are found in Queensland, and two more in Darwin, but the exact identity of these northern forms has not yet been determined. When found together, *micans* and *speciosa* can be readily separated by their size, which is very constant, the specimen of *micans* figured from Little Manly having a maximum diameter of 3.2 mm, that of *speciosa* from North Harbour being 2.1 mm. This difference does not seem great, but it actually represents the comparative difference between a florin and a sixpenny piece, and is very apparent to the eye. The sculpture is very close, but *speciosa* has rather fewer cross ribs, it is flatter, the aperture is much more oblique, and the funicle or rib within the umbilicus is not nearly so prominent. Both species are common in shell sand on the beaches around Sydney, both inside and outside the harbour.

Genus LODDERIA Tate.

Trans. Roy. Soc. South Australia, xxiii, 1899, p. 215.

Genotype: *Lodderia lodderae* Petterd.

A genus related to *Liotia*, depressed turbinate in shape, aperture circular, oblique, with a prominent varix, peristome complete, the sculpture confined to a number of plain spiral keels, umbilicus deep. Operculum white and thick, with a central nucleus, multi-spiral.

Lodderia lodderae Petterd. Figs. 5, 5a..

Hedley 462.

Petterd's name has for a long time been accepted for the New South Wales shell, and gives the species an extensive range, South Australia, Victoria, Tasmania and New South Wales. Tasmanian specimens agree very well with the New South Wales species, but I have not been able to compare them with those from the type locality. Locally the species is a distinctive one, the strong concentric keels and absence of transverse sculpture making its recognition easy. It is common from many localities, mainly on the outer beaches. The specimen figured was living in dead *Teredo* tubes in a piece of driftwood at Long Reef, north of Sydney, its maximum diameter 1.7 mm., its minimum diameter 1.3 mm.

Genus LODDERENA Iredale.

Proc. Linn. Soc. N.S.W., xlix, 1924, p. 233.

Genotype *Liotia minima* Ten. Woods.

The genotype is included in both the New South Wales and Tasmanian check lists as *Lodderia*, and Iredale gives no generic description beyond stating that it should be separated as a distinct genus. If this be accepted, the main differences between the two are that the aperture is more prolonged and the concentric keels are finer and relieved by transverse puckerings adjacent to the sutures and on the base where they make the margin of the umbilicus plicate. The varix surrounding the very oblique aperture is very strong.

Lodderena minima Ten. Woods. Figs. 6, 6a.

Hedley 463.

This is another of Tenison Woods' species, which was unfigured and with an original description insufficient for recognition. Hedley identified it from the New South Wales coast after comparison with specimens from Western Port, Victoria, supplied by J. H. Gatliff, and figured and described the New South Wales shell. This is a very distinctive though minute shell, and the characters as given for the genus *Lodderena* should make its recognition easy. It is not uncommon in shell sand from various localities, mainly on the outer beaches. The specimen figured was dredged in North Harbour, its texture diameter .8 mm., its minimum diameter about .6 mm.

Genus PARTUBIOLA Iredale.

Rec. Aust. Mus. XIX, 1936, p. 286.

Genotype *Partubiola blancha* Iredale.

Iredale combined his generic and specific descriptions, but the features which may be taken as generic are the small, discoidal shell, which is thin and translucent, the sculpture of numerous concentric ridges, the wide umbilicus, the slightly oblique aperture and incomplete peristome, a band of callus on the body whorl linking the anterior and posterior extremities of the inner margin. The systematic position of this genus is uncertain. The simple nature of the shell gives no clue to its true relationship. It may be linked to the Liotiidae; on the other hand, when the animal and operculum become known it may have affinities at present unsuspected.

Partubiola blancha Iredale. Figs. 7, 7a.

Reference as for the genus.

The specimen figured came from 30-35 fathoms off Crookhaven, its maximum diameter 3.7 mm., which is smaller than the type. Otherwise it agrees fairly well, though the concentric ridges on the central portion of the body whorl are very faint and practically obsolete. Above this they are well defined, and steplike to a sharp edge, beyond which the whorl is depressed to the suture, bearing three more faint ridges. The type came from Sydney Harbour dredgings, and it may be that further material will show that more than one species occurs.

Genus MICRODISCULA Thiele.

Deutsch Sud. Pol. Exped. Vol. 12, 1912, p. 199.

Genotype *M. vanhoffeni* Thiele.

This genus was proposed for small shells from the Antarctic and Subantarctic generally resembling the European *Skeneia* but with a different radula. The general features are a thin, transparent shell, with depressed spire, just visible from in front, wide umbilicus and incomplete peristome. Certain Australian shells fit this description, and W. L. May has used it for *Cyclostrema charopa* Tate, which has a slightly higher spire than the genotype. May's figure does not, however, agree with that of Tate, and it is probable that the Tasmanian species is distinct. Three species from New South Wales might also be placed here, though their ultimate verification will depend on the discovery of the animal and comparison of its radula with the true *Microdiscula*.

Microdiscula vitrea, sp. nov. Figs. 8, 8a.

Shell small, thin, colourless and transparent, discoidal, the low spire just visible when viewed laterally. Protoconch minute, naticoid, mature whorls three, rapidly expanding, rounded, depressed above making a distinct hollow to the suture. Surface smooth except for faint growth lines, and a few faint concentric lirae adjoining

the suture. Umbilicus wide and deep, the coiling of the earlier whorls clearly visible. Aperture not quite perfect in the type, but slightly oblique, rounded, the peristome nearly complete, except for a short gap where it is replaced by a narrow band of callus on the body whorl, outer and inner margins thin. Height, about 1.5 mm., maximum diameter 4.1 mm., minimum diameter 3.5 mm.

Locality: North Harbour, Port Jackson.

Remarks: In spite of the simple nature of the shell, there is no Australian shell yet described with which it can be confused. Others undoubtedly exist, and it is hoped that the description of one species will stimulate search for others, and for data to shed light on their true relationship.

Microdiscula pellucida, sp. nov. Figs. 9, 9a.

Shell small, thin, colourless and transparent, discoidal, summit of spire just visible from the side. Protoconch minute and simple, mature whorls three, rapidly increasing, regularly rounded, sutures deep. Sculpture none, except for faint growth lines, surface shining. Umbilicus wide and deep, round, the curvature of the earlier whorls visible within. Aperture wide and rounded, margins thin, peristome almost complete, adhering to the body whorl over a very short distance. Height slightly over 1 mm., maximum diameter 2.5 mm., minimum diameter 1.8 mm.

Locality: Kurnell, Botany Bay, in shell sand.

Remarks: Generally resembles *M. vitrea*, but smaller and with quite different proportions, being much higher in relation to its diameter.

Microdiscula fragilis, sp. nov. Figs. 48, 48a, 48b.

Shell small, white, thin and translucent, discoidal, the spire depressed, its tip just visible when viewed laterally. Protoconch apparently naticoid, slightly tilted and immersed. Mature whorls three, rounded, the earlier whorls just level above with the body whorl, the tip of the spire slightly above, sutures moderately impressed. Surface smooth and shining, the sculpture confined to faint growth lines. Aperture round, its upper margin just below the body whorl, slightly oblique, margins thin, the peristome incomplete, a thin layer of callus connecting it across the body whorl. Umbilicus round, wide and deep. Maximum diameter 1.8 mm., minimum diameter 1.4 mm.

Locality: Abundant in shallow water dredgings, Port Hacking, New South Wales.

Remarks: This is the smallest of the three species here discussed under *Microdiscula*. [It is not quite so flat as *M. vitrea*, and is flatter than *M. pellucida*, and there are differences in the aperture, hard to describe, but best understood by comparison of the figures. The three species have distinct contours when viewed laterally.

Genus BROOKULA Iredale.

Proc. Malac. Soc., x., 1912, p. 119.

Genotype *B. stibarochila* Iredale.

This is a large and on the whole well defined genus, and its usage is uniform by conchologists both in Australia and New Zealand. Typically the species have broadly conical, elevated spires, they are minute, often under 1 mm. in height, umbilicate, the peristome complete but hidden by the overhang of the body whorl, and the sculpture consists of strong transverse ribs, between which are fine and concentric threads. Occasionally the sculpture is ill-defined and even nearly obsolete, but close examination always reveals its presence even if at first sight the shells seem practically smooth. There is also variation in the height of the spire. Some species are more depressed, and in a few, such as *johnstoni* Beddome, a stage is reached where different authors have placed it either under *Brookula* or *Liotella*.

Two species of *Brookula* have been allowed in Hedley's Check List, *B. angeli* Ten, Woods, and *B. crebresculpta* Tate. Both were collected by J. Brazier off Bottle and Glass Rocks, Port Jackson. For various reasons both identifications are open to doubt. When it was made in 1900 the wealth of minute species on the coast was not realised, and a general resemblance was often taken as sufficient identification. *Brookula angeli*, first described as a *Rissoa*, is another of Tenison Woods' wretched species, unfigured and inadequately described. Hedley figured a specimen sent to him as authentic by C. E. Beddome,¹ but W. L. May in his Tasmanian Check List figures quite another species, with far fewer ribs, and certainly more like one of the New South Wales forms

¹ Proc. Linn. Soc. N.S.W. xxv, 1900, p. 503, pl. 25, f. 14.

Tryon in his Manual figures as *angeli* still another species. Later in this paper the N.S.W. species generally known as *angeli* has been given a new name to avoid perpetuating this confusion of identity. *B. crebresculpta* Tate is a South Australian species which has been adequately figured and described, but in twenty years of collecting we have not seen it in New South Wales, and while its record cannot be altogether expunged, some further confirmation is needed before it can be finally accepted. Of the other Tasmanian species none is quite identifiable with those of New South Wales, neither are the one or two so far described from Queensland. This necessitates new specific names for all the New South Wales forms which are here described.

Brookula obscura, sp. nov. Fig. 10.

Shell minute, white, thin, translucent, broadly conical. Protoconch naticoid followed by three mature whorls, increasing regularly, body whorl large. Whorls regularly rounded, sutures deep. Sculpture not prominent, the transverse ribs nearly obsolete and only visible at some angles, the spiral lirae continuous, fine and closely spaced, continuing on the base. Umbilicus narrow but deep. Aperture rounded outer margin thin, inner margin straighter and slightly reflected, peristome complete, but posterior portion hidden from in front by the overhang of the body whorl. Height 1.3 mm.

Localities: Not uncommon in shell sand on the outer beaches. Type from Port Stephens, also many specimens from Manly Ocean Beach.

Remarks: Though of typical shape, the obscure transverse sculpture and continuous spiral lirae remove it from most other species of the group, though in my opinion not sufficiently to justify generic separation. These features should make its future recognition easy.

Brookula jacksonensis, sp. nov. Fig. 11.

Shell minute but large for the genus, thin, white and translucent, conical. Protoconch naticoid, prominent and slightly tilted. Mature whorls four, increasing regularly, rounded, sutures deep. Sculpture very prominent, consisting of narrow, elevated, rounded, transverse costae, about 16 to the whorl, conspicuously white against the translucent surface of the whorl, continuous on to the base and into the umbilicus. The spaces between the costae are much wider than the costae themselves, and are crossed by numerous fine spiral lirae. Umbilicus narrow but deep. Aperture rounded, with simple outer margin, inner margin slightly reflected, peristome complete, but its posterior portion hidden from in front by the overhang of the body whorl, the whole aperture anteriorly produced. Height 1.5 mm.

Locality: Manly Beach (type); not uncommon in shell sand here and on other outside beaches.

Remarks: This approaches closely to *B. nepeanensis* Gatliff, a Victorian species also recorded from Tasmania. It is, however, rather narrower and with an extra whorl, and the transverse costae are rather more numerous.

Brookula augeria, sp. nov. Fig. 12.

Shell minute, broadly conical, thin, white. Protoconch naticoid, prominent. Mature whorls three, increasingly regularly, rounded, with deep sutures. Sculpture prominent, on the body whorl about 12 broad, rounded and elevated transverse costae; on the two earlier whorls the costae are smaller, numerous and close together. The costae are continuous on the base and bend upwards into the umbilicus. The spiral lirae are strong and are continuous, overriding the transverse costae. Umbilicus narrow and deep. Aperture rounded, in the type the outer margin expanded by the latest of the main costae, inner margin slightly reflected, the peristome complete, adherent posteriorly to the body whorl whose overhang makes it invisible in front. Height 1.2 mm.

Locality: 40-50 fathoms off Twofold Bay.

Remarks: This species is very close to *B. jacksonensis*, of which it may be considered the deepwater representative. It differs by having one whorl less, by being relatively broader, by having fewer costae on the body whorl, and by the crowding of the costae on the earlier whorls. It also resembles the figure given by May of *B. angeli* Ten. Woods, but for reasons already given this name has been discarded as from New South Wales.

Brookula turbinata sp. nov. Fig. 13.

Shell minute, white turbinate with a low spire. Protoconch prominent, naticoid, smooth, the costae of the adult sculpture appearing quite suddenly. Mature whorls three, rounded, sutures deep. Sculpture well defined, consisting of numerous, sharp, narrow, elevated transverse costae, about 20 on the body whorl, narrower than the intercostal spaces, continuous on the base and ascending into the umbilicus. Numerous spiral lirae cross the spaces between the costae. The umbilicus is moderately wide, round and deep. Aperture rounded, slightly angulated posteriorly, peristome complete, separate from the body whorl, but slightly hidden by the overhang of the body whorl when viewed from in front, margins thin. Height .9 mm.

Localities: 40-50 fathoms, Twofold Bay (type); another specimen from shell sand, Port Stephens.

Remarks: This is a beautiful little species, easily recognised by its shape and its sharply defined, regular sculpture. It is the first of several species showing progressively a reduction in the height of the spire, a corresponding increase in the size of the umbilicus and a complete development of the peristome, until the border line of *Brookula* and *Liotella* is reached.

Brookula orospatia, sp. nov. Fig. 14.

Shell minute, conical white. Protoconch prominent, naticoid and smooth, adult sculpture appearing gradually. Mature whorls three, rounded, sutures deep. The transverse sculpture is distinct but not prominent, the costae are narrow, about 22 on the body whorl, not elevated and not so well defined as shown on the figure, particularly on the base where they become faint before they finally ascend into the umbilicus. The spiral lirae are fine, numerous and well defined, particularly on the base. Umbilicus narrow and deep. Aperture rather elongate, the peristome adherent in its posterior portion to the body whorl, the outer margin thin and rounded, the inner margin nearly straight, the anterior margin bent back and extended. Height 1.3 mm.

Locality: 40-50 fathoms, Twofold Bay.

Remarks: The weak transverse sculpture separates this from most of the New South Wales species with high spires, but the shape of the aperture with its reflected anterior margin is the most conspicuous specific character.

Brookula sp. Fig. 34.

A single specimen of what is apparently a different species of *Brookula* was sorted from dredgings from 6-9 fathoms, Sow and Pigs Reef, Port Jackson, and is here figured for future reference. Further material is needed before a new specific name is proposed. In form this specimen generally resembles *B. turbinata*, but is nearly smooth, only traces of transverse sculpture appearing on the upper whorls and similar traces of concentric sculpture here and there. The indefinite sculpture may be partially due to wear, but the characters of the aperture are sufficiently distinctive to suggest that ultimately this must be still another species to add to the New South Wales list. The height of the specimen is about 1 mm.

Brookula finesia, sp. nov. Fig. 15.

Shell minute, turbinate with a low spire, white. Protoconch naticoid of two whorls, smooth. Mature whorls three, increasing regularly, rounded, sutures deep. Sculpture well defined, the transverse costae sharp, narrow and very numerous, close together, in width about equal to the intercostal spaces, continuous on the base and ascending into the umbilicus. The spiral sculpture is not prominent, consisting of fine lirae just visible between the costae. Aperture round, slightly oblique, peristome nearly entire, joined for a very narrow space posteriorly to the body whorl, umbilicus relatively wide, circular and deep. Height of shell 1.3 mm., maximum diameter of base 1.6 mm.

Locality: 30-35 fathoms off Crookhaven.

Remarks: This is a very beautiful and distinctive little species, the turbinate shape and sharp, finely-packed costae being useful features for future recognition. Systematically it seems on the border line between *Brookula* and *Liotella*, and might indeed be placed in either genus, the spire in height intermediate between the two with the rounded deep umbilicus and the aperture approaching the typical *Liotella*. Its nearest ally is *B. densilaminata* Verco, which has a slightly higher spire, but is otherwise very similar.

Brookula tumida, sp. nov. Fig. 16.

Shell minute, conical, white. Protoconch naticoid and smooth. Mature whorls three, rounded, the centre whorl swollen, relatively large, making the spire higher than normal and giving a distinct facies to the contour, the sutures deep. Sculpture not prominent, the transverse costae few and ill-defined, fading at the periphery, the spiral lirae continuous, very fine and not at all conspicuous. On the type the transverse costae become more conspicuous on the back of body whorl and near the aperture, where they consist of broad, low, rounded folds. Aperture rounded, peristome not quite complete, the inner margin slightly flattened and slightly reflected anteriorly. Umbilicus narrow, little more than a deep slit. Height 1.6 mm.

Locality: 40-50 fathoms, off Twofold Bay.

Remarks: This approaches close to *B. obscura*, already described in this paper, which is the common shallow water species near Sydney, and the opinion might possibly be held that it is but a deep water variety of that species. It is, however, relatively higher in proportion to its width, and the tumid median whorl gives it a distinct facies. There is no known Tasmanian species with which it can be compared.

Genus LIOTELLA Iredale.

Trans. New Zealand Inst., xvii, 1914, p. 442.

Genotype *Liotia polypleura* Hedley.

Iredale proposed *Liotella* for shells without a thickened peristome which are more or less loosely coiled, and having a multispiral operculum, with a central nucleus. To this may be added that the spire is depressed, the umbilicus wide and deep, the whorls are rounded and the sculpture consists of strong transverse ribs, with the spiral sculpture confined to fine lirae between the ribs or nearly or entirely obsolete. Among the species placed under *Liotella* there is considerable variation in the height of the spire; some species have the spire so elevated as to approximate to a depressed *Brookula*, others have it so depressed that the summit is quite flattened and the shell is coiled nearly within the one plane. Within these limits *Liotella* seems to form a natural genus whose recognition is comparatively easy.

Liotella princeps, sp. nov. Figs. 17, 17a.

Shell minute, depressed turbinata, spire laterally visible, white. Protoconch minute, smooth, but details not observable. Mature whorls three, rounded, sutures very deep, the whole loosely coiled, becoming slightly uncoiled towards the aperture. Sculpture prominent and well defined, consisting of numerous, sharp, well-raised transverse costae, 11 of which are visible on the front portion of the body whorl when viewed in profile. The intercostal spaces are about twice the width of the costae themselves. There is no trace of spiral sculpture, and the intercostal spaces are smooth. The costae are continuous from the sutures round the whorl and ascend vertically into the umbilicus. Aperture round, the peristome complete, the body whorl slightly uncoiled with the aperture pointing slightly downwards. Umbilicus round, well defined and deep. Major diameter 1.3 mm., minimum diameter .9 mm.

Locality: 15-25 fathoms, off Crookhaven.

Remarks: This is probably the species recorded by C. Hedley from the "Thetis" Expedition as *Cyclostrema johnstoni* Beddome, and included in the Check List as *Liotella* (No. 460). Unfortunately, *johnstoni* is another rather unsatisfactory species, as the original description was short and unaccompanied by a figure. Both May and Tate later figured *johnstoni*, but their figures do not quite agree, and it is probable that May's figure from a Tasmanian shell is the correct species. May shows a shell with a rather higher spire than ours, brown in colour, and, in fact, he places it under *Brookula*. Amongst New South Wales species, the slight uncoiling of the body whorl, and the downward pointing aperture, should prove ready recognition points.

Liotella littoralis, sp. nov. Fig. 18.

Shell minute, depressed turbinata, spire laterally visible, white. Protoconch naticoid, smooth. Mature whorls three, rounded, sutures deep. Sculpture strong and well defined, consisting of numerous elevated sharp costae, continuous from the sutures across the whorls and into the umbilicus, the intercostal spaces about 1½ times the width of the costae, spiral sculpture absent. Fourteen costae are visible on the front portion of the body whorl when viewed laterally. Aperture rounded,

peristome entire, separate from the body whorl, but not pointing downwards as in *L. princeps*. Umbilicus round, wide and deep. Maximum diameter 1 mm., minimum diameter .7 mm.

Localities: Shell sand, Port Stephens (type); Manly Ocean Beach; not uncommon on outer beaches.

Remarks: This is closely allied to *L. princeps*, but has a slightly deeper body whorl, the costae are rather more numerous and more closely placed, and the aperture does not point downwards.

Liotella parvirota, sp. nov. Figs. 19, 19a.

Shell minute, discoidal, coiled in nearly one plane so that the spire is slightly below the rim of the body whorl, and there is little difference in appearance between the lower and the upper surface of the shell; white. Protoconch minute, smooth, apparently a short, conical cap. Mature whorls three, round, the sutures deeply indented, the body whorl becoming separate just before the aperture. Aperture round, peristome complete and separate from the body whorl. Sculpture consisting of fine, sharp, well-elevated costae, far apart, only seven visible on the body whorl when viewed from in front, continuous round the whorls, from the sutures above to the sutures visible within the wide umbilical cavity. Faint traces of spiral lirae appear under high magnification in the intercostal spaces. Maximum diameter .8 mm., minimum diameter .6 mm.

Localities: Reclamations Bayview, Pittwater (type); not uncommon in shell sand on the outer beaches, Port Stephens, Manly Beach, and Shellharbour.

Remarks: This is possibly the species recorded as *L. annulata* Ten. Woods, by Hedley from the "Thetis" Expedition. Beyond knowing that the type of *annulata* came from Tasmania, there is no certainty as to what that species is. Both May and Tate figured different species as *annulata*, and Tryon in his Manual rejected the species as indecipherable. Under the circumstances it has been thought better to give the New South Wales species a new name rather than perpetuate one which will ever be open to doubt. There should be no difficulty in recognising the species in the future. It is probably the smallest of the local species; the flat, almost symmetrical coiling is distinctive, as is the wide distance separating the sharp, well-defined costae.

Liotella compacta Petterd was figured as *annulata* by Tate, but seems to be the young of *Liotia mayena* Tate.

Liotella pulcherrima Brazier. Figs. 20, 20a.

Hedley 461.

This beautiful little species is one of the most distinctive on the coast, and is easily recognisable by its flat, discoidal shape, not quite so symmetrical as *L. parvirota*, and the fineness of its sculpture, the costae being very numerous, fine, and closely packed. Unlike most other *Liotellas*, spiral sculpture is very defined, consisting of very fine lirae crossing the spaces between the costae but not overriding them, so the shell is hardly cancellate as stated by the author. The specimen figured is from Manly Ocean Beach, its maximum diameter 1.3 mm., its minimum .9 mm.

Liotella capitata Hedley.

Hedley 457.

I have not seen this species and am unable to provide an illustration, but Hedley's figure and description are adequate, and there should be no difficulty in its recognition should it ever be found again. The type was a single specimen found in the great depth of 800 fathoms, 35 miles east of Sydney, right on the edge of the continental shelf, a locality only accessible to a properly equipped, deep sea dredging expedition. For reference it may be noted that it is rather similar to *L. patonga*, described in this paper, but differs chiefly in the rather higher spire, the more steeply descending aperture, and the crowding of the costae on the penultimate whorl.

Liotella patonga, sp. nov. Figs. 32, 32a, 32b.

Shell minute, subdiscoidal, the spire just visible when viewed laterally, white. Protoconch minute, apparently rather conical and elongate. Mature whorls three, rounded, sutures deep, slightly uncoiled towards the aperture which is turned slightly downwards. The sculpture is well defined, consisting of broad, elevated, widely separated transverse costae, only seven visible on the body whorl when viewed from in front, more prominent on the periphery and thinning towards the sutures on top

and the umbilicus below. Aperture round, separate, turning slightly downwards, umbilicus wide, round and deep. Maximum diameter 1.2 mm., minimum diameter .8 mm.

Localities: Patonga, Broken Bay, in shell sand (type); also on Manly Ocean Beach.

Remarks: This is the closest in relationship to *L. capitata* Hedley, and together they form a link between *Liotellas* with a depressed turbinate shape as *L. princeps*, and those which are discoidal as *L. parvirota*.

Liotella gravicosta, sp. nov. Figs. 33, 33a

Shell minute, suborbicular, spire just visible when viewed laterally, white. Protoconch undetermined. Mature whorls three, rounded, sutures deep. Sculpture strong and well defined, consisting of numerous, broad, well-elevated, rounded costae, 11 visible on the body whorl when viewed from in front, about equal in width to the intercostal spaces, continuous from the sutures round the whorls and ascending into the umbilicus, spiral sculpture absent. Aperture just below the previous whorl, not oblique, large, irregularly rounded, flattened above and obliquely flat on the inner margin, peristome complete and free from the body whorl, umbilicus large, rounded and deep. Maximum diameter .9 mm., minimum diameter .7 mm.

Locality: 55 fathoms, off Montagu Island.

Remarks: This has coarser sculpture than any of the other Australian species, and the broad, prominent costae, the form of the shell and the flattened upper margin of the aperture are good recognition points.

Genus LIOCARINIA gen. nov.

Genotype *Liotia disjuncta* Hedley.

Mem. Australian Mus., iv, 1903, p. 336, f. 66.

Shell with the general characters of *Liotella*, the shell loosely coiled, the aperture becoming separate and without a varix. It differs from *Liotella* in that the whorls are not rounded but strongly keeled, the genotype having a strong spiral keel at the periphery and another at the base of the whorl, between which the space is slightly concave, the transverse ribs descending vertically. The species described as *Omalaxis radiata* Hedley from the Masthead Islands, Queensland, will also come here.

Liocarina disjuncta Hedley. Figs. 41, 41a (after Hedley).

Hedley 459.

This beautiful, distinctive little shell was collected by the "Thetis" Expedition from 41-50 fathoms, off Cape Three Points, on the continental shelf. Hedley's full description and excellent figures should make its future recognition beyond doubt.

Genus CIRSONELLA Angas.

P.Z.S., 1877, p. 38.

Genotype *Cirsonella australis* Angas.

The description given by Angas is "shell minute, globosely turbinate, smooth, narrowly umbilicated; aperture circular, peritreme continuous, slightly thickened." To this can be added that the operculum is brown, apparently horny, large, not retracted into the shell, thick, with a central nucleus and multispiral. The aperture also is oblique. Angas placed it provisionally in the Trochidae, but it probably needs a separate family and may not be far removed from the Liotiidae. Iredale's genus *Lissotesta* almost comes here, but may be retained to designate somewhat smaller shells of thinner texture and with the peristome incomplete.

Cirsonella australis Angas. Figs. 27, 27a.

Hedley 449 (*Cirsonella weldii* Ten. Woods).

Hedley synonymised *C. australis* under *C. weldii*, the type locality of which is Tasmania. As usual with Tenison Woods' species, no figure was provided, and the description is insufficient for identification. Tate and May² figured as *weldii* a shell with similar general characters to the Sydney shell, but with a more depressed spire. In view of this, and as Angas' figure is good and his description clear, I think it far better to restore his name to cover the New South Wales species. The specimen here figured is from the type locality, dredged off the Sow and Pigs Reef, Port Jackson, and the dimensions are: maximum diameter 2 mm., minimum diameter 1.7 mm., height slightly under 2 mm. The shell is white, smooth, hardly translucent, the peristome quite free from the body whorl, and the inner margin of the aperture is reflected slightly.

² Proc. Linn. Soc. N.S.W., xxvi, 1901, p. 397, f. 8,

Cirsonella reflecta, sp. nov. Figs. 28, 28a.

Shell minute, turbate, white, translucent. Protoconch minute, apparently naticoid. Mature whorls three, the body whorl large, rounded, sutures deep. The surface is smooth except for faint growth lines. Aperture round, very oblique to the axis of the shell, outer margin round, inner margin slightly flattened and reflected, a narrow shelf commencing from the inner margin into the umbilicus, which it partly fills. Umbilicus round, narrow and deep, and owing to the rotundity of the body whorl appearing larger when viewed from in front. The peristome is complete, the aperture quite separate from the body whorl. Maximum diameter 1 mm., minimum diameter .8 mm.

Locality: 6.9 fathoms, Sow and Pigs Reef.

Remarks: This is a much smaller shell than *Cirsonella australis* Angas and has a more depressed spire. The narrow shelf partially filling the umbilicus is not a conspicuous character, but is important in its specific determination. A similar structure is found to an even more marked degree in the shell named by Hedley *Teinostoma starkeyae*, which is four times the size and even more depressed.

Cirsonella perplexa, sp. nov. Figs. 21, 21a.

Shell minute, turbate, white, sub-translucent. Protoconch minute, apparently naticoid. Mature whorls three, the body whorl rounded, sutures deep. Defined sculpture absent, but irregular growth lines present, more prominent on the base. Aperture round, oblique to the axis of the shell, outer margin round, inner margin straightened, strongly reflected, and in older specimens thickened, overhanging and partially obscuring the umbilicus, which is round, narrow and deep. Peristome complete, the aperture quite separate from the body whorl. Maximum diameter 1.3 mm., minimum diameter 1 mm.

Locality: 40.50 fathoms, off Twofold Bay.

Remarks: This is very close to and almost indistinguishable from *C. reflecta*, and it was only after repeated examination that it was concluded that they were distinct. *C. perplexa* is the larger of the two, and the aperture is not so oblique, but the vital character is the presence of a shelf in the umbilicus of *C. reflecta* that is absent in *C. perplexa*.

This possibly also is the species included in the New South Wales list as *Lissotesta micra* Ten. Woods, and it agrees fairly well with May's figure of that species. But from the meagre information provided by the original author it agrees also with *Cirsonella weldii* Ten. Woods. Whether this and some other species by the same author should be rejected altogether as indecipherable is perhaps a matter of opinion, but at the risk of synonymy it has been thought better to give a new name to a well-defined species from the New South Wales coast. If further evidence indeed decides that this is the species *micra*, I have no doubt that it is congeneric with *Cirsonella australis*, and then as *micra* is the genotype of *Lissotesta* my interpretation of that genus is wrong, and *Lissotesta* disappears as a synonym of *Cirsonella*.

Genus LISSOTESTA Iredale.

Trans. New Zealand Inst., xlvii, 1914 (1915), p. 442.

Genotype *Cyclostrema micra* Ten. Woods.

It is unfortunate that Iredale chose this species as his genotype, as, like most of Tenison Woods' species, it was unfigured and inadequately described, and its exact identification has always been in doubt. As Iredale also gives no generic description, it is necessary to deduce generic characters from the meagre characters known of the genotype and from the general interpretation by authors in the New Zealand, Tasmanian and New South Wales check lists.

In this paper *Lissotesta* is used to designate minute shells, turbate or broadly conical in shape, of few whorls, thin and transparent, devoid of sculpture, narrowly umbilicate, the peristomes either complete or joined over a brief gap anteriorly by a layer of *callus* on the body whorl, the apertures rounded without a varix and more or less oblique. Operculum unknown. It is possible that a knowledge of the animal will show a considerable diversity between the various species and necessitate a further revision of classification.

Lissotesta arenosa, sp. nov. Figs. 22, 22a.

Shell minute, globosely turbate, thin, colourless and transparent. Protoconch

minute, apparently naticoid. Mature whorls three, rounded, the body whorl large and inflated, sutures deep. Sculpture none, the surface smooth and shining. Aperture simple, rounded (oblique to the axis of the shell), margins thin, the peristome incomplete, a narrow band of callus across the body whorl. Umbilicus narrow, round and deep. Maximum diameter .9 mm., minimum diameter .7 mm.

Localities: Dredged in shallow water, North Harbour, Port Jackson (type); also abundant dredged in shallow water, Port Hacking.

Remarks: This is another of the species which will fit the meagre description provided of *Cyclostrema micra* Ten. Woods. In form it resembles the shell here described as *Cirsonella reflecta*, but of course the incomplete peristome and other aperture characters are quite different. In spite of its minute size its shining vitreous shell makes it easily picked out and recognised.

Lissotesta inscripta Tate. Figs. 36, 36a (after Hedley).

Hedley 453.

This species was recorded by Hedley from 40 to 60 fathoms on the continental shelf, but Hedley was not positive in his identification, pointing out that the measurements did not coincide. The diameters of the specimen he figured are 1.9 mm. maximum and 1.5 mm. minimum, and it is probable that the New South Wales species is different from the type and needs a new name. As no material is available for description, however, *L. inscripta* may provisionally be retained as a member of the New South Wales fauna.

Genus CONICELLA gen. nov.

Genotype *Cyclostrema porcellana* Tate & May.

A genus related to *Lissotesta*, but with a conical, elevated spire, and the umbilicus small, round and deep. Shell substance thin and translucent, sculpture confined to faint growth lines, aperture slightly oblique, peristome incomplete, joined by a thin layer of callus on the body whorl, margins of aperture thin and without a varix.

The genotype is included in both the New South Wales and Tasmanian lists as *Lissotesta*, but as there are several species of the same type, that is with elevated and conical spires and narrow umbilici, they may well be separated generically.

Conicella porcellana Tate & May. Fig. 38.

Hedley 455.

This species was recorded by Hedley from the "Thetis" Expedition in 40-50 fathoms, off Cape Three Points. We have a single specimen from 30 to 35 fathoms, off Crookhaven. This agrees very well with the original description, and unless ultimate comparison with the type reveals differences, it may be retained on the New South Wales list. A feature of the shell is the white, porcellanous surface, making it easy of recognition. The specimen figured is 1.7 mm. high.

Conicella lacuna, sp. nov. Figs. 39, 39a.

Shell minute, thin, white, translucent, conical, with elevated spire. Protoconch small, naticoid. Mature whorls four, the body whorl large, rounded, slightly shouldered at the sutures, which are well impressed. Sculpture none, the surface smooth and vitreous. Aperture ovate, slightly angled posteriorly, slightly produced anteriorly, the outer margin thin, inner margin reflected, the peristome incomplete, but the callus on the body whorl so thickened as to make it appear complete. The umbilicus from in front appears as a narrow slit overhung by the reflection of the inner margin of the aperture; from below it appears as a very narrow but deep, round hole. Height 1.3 mm.

Locality: 6-9 fathoms, Sow and Pigs Reef, Port Jackson.

Remarks: This is very close to *C. porcellana* as collected from the continental shelf, but is smaller, slightly narrower, has a vitreous rather than a porcellanous texture, and differs also slightly in the details of the aperture and umbilicus. A single specimen from the Manly Ocean Beach is similar, but has a perfectly transparent shell; another from the Sow and Pigs is larger and with the inner margin less reflected. It is possible that longer series will show that there are other close but distinct species.

Conicella lata, sp. nov. Figs 37, 37a.

Shell minute, broadly conical, colourless and transparent. Protoconch minute, naticoid. Mature whorls three, expanding rapidly, the body whorl large, rounded, the sutures impressed. Sculpture none, the surface polished and vitreous. Aperture

ovate, produced anteriorly, outer margin thin and rounded, the inner margin straight and strongly reflected and somewhat thickened, overhanging the umbilical cavity. Peristome incomplete, a thin line of callus on the body whorl. Umbilicus wider than the other species, round and deep. Height 1.6 mm.

Locality: Manly Ocean Beach (collected Mr. Tom Iredale).

Remarks: This is relatively shorter and much broader than the other two species here described, the body whorl is relatively larger, the inner margin is straighter, and the umbilicus is larger. In the figure the upper portion of the body whorl has been accidentally drawn rather flattened, whereas the curvature should continue regularly upwards to the suture.

Genus WANGANELLA, gen. nov.

Genotype *Wanganella fissura* Laseron.

Shell minute, conical, few rounded whorls, shell substance moderately thick, smooth white and translucent, narrowly perforate, aperture slightly oblique, inner margin vertical, peristome incomplete, umbilicus a narrow slit.

This is another of the odd Australian shells which will not fit into known genera. Its exact relationship is uncertain, but it is possibly related to *Cirsonella* and cognate forms, but differs in the elevated spire, the incomplete peristome, the thicker shell substance, the narrow umbilical slit, and the straight and vertical inner margin of the aperture.

Wanganella fissura, sp. nov. Figs. 40, 40a.

Shell minute, conical, shell substance moderately thick, colourless and translucent. Protoconch minute and naticoid. Mature whorls four, increasing regularly, rounded, sutures deep, a narrow opaque band, well defined and slightly indented just below the sutures, body whorl large. Aperture with rounded outer margin, making an angle anteriorly with the straight, almost vertical inner margin which overhangs a very deep, narrow vertical umbilical slit. Height 2 mm. There is no sculpture and the surface is smooth and polished.

Locality: Shell sand, Port Stephens, a number of specimens.

Remarks: In general shape this resembles the South Australian *Lissotesta porcellana* Tate & May, but differs generically as well as specifically in the characters of the aperture and in its thicker shell.

Genus STARKEYNA Iredale.

Stipator Iredale, Proc. Linn. Soc. N.S.W., xlix, 1924, p. 233.

Preocc. by Rehn, 1900, in Insecta.

Starkeyna Iredale, Australian Zoologist, 1930, p. 175. Substitute for *Stipator*, preocc.

Genotype: *Teinostoma starkeyae* Hedley.

As Iredale gave no generic description, the following characters may be taken as characteristic: Shell small, depressed turbinate, whorls few, perforate, smooth, thin and translucent, aperture without a varix, oblique, a spur developing from the inner margin and partially filling the umbilicus, which is narrow and deep, a callus on the body whorl.

Though Hedley placed his species in *Teinostoma*, it certainly does not belong there, as Adam's genus is imperforate with a thick callus filling the whole of the umbilical area. Its exact relationship is uncertain, but it may well be related to *Cirsonella*, the species *C. reflecta* forming a connecting link between the two genera.

Starkeyna starkeyae (Hedley). Figs. 35, 35a (after Hedley).

Hedley 448.

So far I have not seen this species, though the type locality is Balmoral, and the shell is by no means minute, being 4 mm. across its maximum diameter. The characters given in the generic description as well as the figure should make its future recognition not difficult.

Genus CHARISMA Hedley.

Proc. Linn. Soc. N.S.W., xxxix, p. 711.

Genotype *Charisma compacta* Hedley.

Hedley's description reads. "A new genus related to *Liotia*, but without a varix to the outer lip, few-whorled, spirally sculptured, umbilicus with an internal funicle

Operculum corneous, concave, multispiral, with a spiral frilled lamella." To this may be added as characters of generic value that the shape is conical, the spire elevated, and the shell is thick and heavy.

Charisma compacta Hedley. Fig. 29.

Hedley 468.

This species in an inhabitant of the continental shelf, the type coming from 100 fathoms, north-east of Port Macquarie. It must have a fair range in depth, as we obtained numerous specimens in 14 fathoms off Long Reef, near Sydney, the specimen figured being 3 mm. in height, larger than the type but otherwise indistinguishable.

A second species of *Charisma* appears on the New South Wales list, *C. latebrosa* Hedley (Check List No. 469). The type locality of this is the Masthead Reef, Northern Queensland, and I am unable to find any reference in literature as to its definite occurrence on the New South Wales coast, and until further evidence is obtained it seems wiser to reject it from the local fauna. Incidentally, *latebrosa* does not appear congeneric with *compacta*, as among other characters it has a different operculum.

Genus CAVOSTELLA, gen. nov.

Genotype *Cavostella radians* Laseyron.

A genus probably related to *Liotia*, small, depressed turbinata, with few whorls, fine concentric sculpture, no varix on the outer lip, aperture oblique with complete peristome, the inner margin reflected into a narrow undulating platform, the umbilicus round and deep, indented with radiating furrows on the base.

This is another of the peculiar Australian shells which will not fit into any of the known genera. It belongs to one of a group which formerly would have been included in *Cyclostrema* of Marryatt, a name almost as widely used as *Helix* was used among land shells.

No shell approaching *Cavostella* has been yet recorded from localities south of Sydney, but there are some species as yet undescribed from Queensland which will probably fit here.

Cavostella radians, sp. nov. Figs 30, 30a.

Shell minute, depressed turbinata, moderately thick in substance, white and translucent. Protoconch minute, exact form not determined. Mature whorls three, the body whorl large, rounded, sutures not deep, spire visible when laterally viewed. Sculpture clear and distinct, consisting of fine, very numerous rounded concentric ridges, closely packed, about their own width apart, and persisting right on to the base to the edge of the umbilicus. Transverse sculpture absent. Aperture round, oblique to the axis of the shell, separate from the body whorl, peristome complete, the inner margin strongly reflected into a narrow undulating platform partially overhanging the umbilicus. Base with a number of radiating furrows indenting the margin of the umbilicus, which is round, fairly broad and deep. Maximum diameter, 1.9 mm., minimum diameter 1.5 mm.

Locality: Shell sand, Port Stephens, a number of specimens; (type) 6-9 fathoms, Sow and Pigs Reef.

Remarks: I know of no described Australian shell with which this can readily be compared, but its characters are so distinct and well defined that there should be no trouble in its future recognition.

Genus CAVOTERA, gen. nov.

Genotype: *Cavotera simplex* Laseyron.

A minute genus, similar to *Cavostella*, but without the radiating furrows on the base indenting the umbilicus. Like *Cavostella*, the shape is depressed turbinata, the shell substance is translucent, the peristome is complete, the aperture oblique, the sculpture finely concentric.

Cavotera simplex, sp. nov. Figs 31, 31a.

Shell minute, depressed turbinata, the spire visible when laterally viewed, fairly solid, white and translucent. Protoconch exceedingly minute, apparently naticoid, placed in a small depression in the summit of the shell. Mature whorls three, rounded, the body whorl large. Sculpture very fine, but well defined, consisting of numerous, closely-packed spiral ridges, persistent on the base to the edge of the umbilicus. On the periphery of the body whorl a few spiral ridges are slightly

larger than the others, giving a very slight and irregular angularity. Transverse sculpture none. Aperture round, oblique to the axis of the shell, peristome complete, the inner margin reflected and thickened, partially overhanging the umbilicus. Umbilicus round, narrow and deep. Operculum thick and white, nucleus sub-central. Maximum diameter .9 mm., minimum diameter .7 mm.

Locality: Port Stephens in shell sand (type); alive under stone, Long Reef (T. Iredale).

Remarks: In general form this is similar to *Cavostella radians*, but it is only half the size, differs slightly in contour, the umbilicus is narrower, there are no radiating furrows on the base, and the inner margin of the aperture differs in detail.

Genus CALLOMPHALA Adams & Angas.

P.Z.S. 1864, p. 35.

Genotype: *Neritula (Callomphala) lucida* Adams & Angas.

As applied to Australian shells, this is a well defined genus, and its characters fit with the original description. The main generic characters may be taken as the smooth, polished shell of a depressed turbinata shape, the aperture very oblique and prolonged, the outer lip terminating in a thick varix, the whole of the umbilical region covered with a thick callus, imperforate.

Callomphala lucida Adams & Angas. Figs. 23, 23a.

Hedley 446.

This is a common and well-defined species found on beaches both inside and outside the harbours on the coast. The specimen figured is from Port Jackson, its maximum diameter 5 mm., its minimum diameter 3.8 mm. Its smooth, lustrous, translucent shell, its oblique and extended aperture, terminated with a thick varix, make it very easy of recognition. A feature of the thick callus covering the umbilical region is that it is minutely pitted and thus has a matte surface in contrast to the lustrous surface of the shell proper.

Callomphala alta, sp. nov. Figs. 26, 26a.

Shell small, turbinata, stout, generally white, but the type brownish (? discoloured), sub-translucent. Protoconch minute, naticoid, glassy, slightly tilted, set in a minute depression at the summit of the spire. Mature whorls three with a rather pointed spire, body whorl greatly inflated, rounded, sutures not deep. Sculpture confined to slight growth lines, the surface smooth and lustrous. Aperture laterally extended, very oblique, outer margin rounded and fortified with a thick varix, peristome incomplete, particularly noticeable in immature shells, a thick layer of callus beginning posteriorly on the inner margin and widening anteriorly to spread in a circular disc over the whole of the umbilical region. Height about 2 mm., maximum diameter 3.2 mm., minimum diameter 2.8 mm.

Locality: Dredged Shoal Bay, Port Stephens (type and a number of specimens); dredged North Harbour, Port Jackson.

Remarks: This is quite a distinct species from *C. lucida*, being much smaller, the body whorl more globose and higher, the spire more elevated, and the aperture less prolonged laterally. It approaches nearer in shape to *C. globosa* Hedley from 30 fathoms, Torres Strait, but that species is still more globose and has fine spiral striae.

Genus ROTOSTOMA gen. nov.

Genotype: *Ethalia brazieri* Angas, Proc. Zool. Soc., 1877, p. 39, pl. 5, f. 17.

Shell small, depressed turbinata, few whorls, solid, imperforate, aperture oblique, extended laterally, without a varix, a thick layer of callus forming the inner margin and covering the umbilical region. Sculpture confined to the concentric striae adjoining the sutures.

The genotype was originally placed in *Ethalia*, but Pilsbury as long ago as 1889 (Man. Conch., xi, p. 462) suggested it should be transferred to *Teinostoma*. In his Check List Hedley included it as a *Callomphala*, but this cannot be sustained, as it entirely lacks the varix of that genus. Neither will it fit with *Teinostoma* H. & A. Adams. It is doubtful if *Teinostoma* proper occurs at all in southern Australian waters. Its genotype, *T. politum* Adams, is a larger, heavier shell, quite smooth, the aperture is angulated, and the umbilical callus is greatly developed, much more than in *Rotostoma*. Hedley has used *Teinostoma* for various Australian shells,

but I think his interpretation is incorrect, as it is applied to perforate shells with an open umbilicus.

Rotostoma brazieri (Angas). Figs. 24, 24a.

Hedley 447 (*Callomphala*).

The type locality is Sow and Pigs Reef, and the specimen figured was dredged nearby in North Harbour, Port Jackson, its maximum diameter 3.7 mm., its minimum diameter 2.9 mm. It is not uncommon, in appearance not unlike *Callomphala lucida*, but of course without the thick varix of that species. There is no other southern Australian shell with which it can be confused, and a further good recognition point is the faint concentric sculpture confined to a narrow area adjoining the sutures. The remainder of the shell is smooth and polished.

Genus CALLODIX, gen. nov.

Genotype: *Callodix solida* Laseron.

A genus probably related to *Teinostoma*, small and with a depressed spire, solid, few-whorled, the sculpture fine concentric ridges, the aperture extended and very oblique, without a varix, the callosity on the base striated and greatly developed, forming not only the inner margin and covering the whole of the umbilical area, but extending above the aperture on to the body whorl, where it partially obscures the suture.

Callodix solida, sp. nov. Figs. 25, 25a, 25b.

Shell small, solid, depressed, almost oval when viewed laterally, white. Protoconch exceedingly minute, details unobservable, but in a small depression and tilted. Mature whorls two, the body whorl forming most of the shell and overlapping the earlier whorl on top, rounded, suture slight. Sculpture consisting of fine spiral edges, closely packed, and covering the whole of the base as well as the upper portion of the whorl. Transverse sculpture none. Aperture greatly extended laterally, very oblique, the outer margin rounded and without a varix, the inner margin composed of a thick callus which extends well into the aperture, covers the whole of the umbilical region, and extends posteriorly on to the summit of the body whorl. The umbilical callus is ridged transversely in relation to the aperture. Maximum diameter 2.6 mm., minimum diameter 1.9 mm., height about 1 mm.

Locality: 14 fathoms off Long Reef, near Sydney, three specimens.

Remarks: This unique little shell is so different from any other on the coast that there should be no difficulty in its future recognition. I know of no species with which it can readily be compared.

Genus HELISALIA, gen. nov.

Genotype: *Helisalia liliputia* Laseron.

A genus of minute brown shells, thin and in appearance not unlike some land shells, discoidal, coiled in practically the same plane and partially involute with incomplete peristomes. Widely umbilicate, the aperture rounded and thin, sculpture confined to faint growth lines.

In one species, not the genotype, the operculum is white and thick, but details could not be observed, though it recalls the operculum of some of the Liotidae, with which family it may possibly be related. The exact systematic position must, however, be left for the present in abeyance. The usual habitat is on various algae in rock pools and below low tide and were it not that they were taken alive, specimens might well be taken for minute land shells washed down from the shore.

Helisalia liliputia, sp. nov. Figs. 45, 45a.

Shell minute, among the smallest if not the actual smallest shell in existence, red brown, discoidal, the spire impressed below the body whorl, shell substance thin, horny and translucent. Details of protoconch indeterminable, apparently infolded. Mature whorls three, rounded and partially involute, coiled in nearly the same plane, the summit of the shell only slightly flatter than the lower surface, which is broadly umbilicate. Sutures well impressed. Sculpture confined to fine growth lines. Aperture large and rounded, not oblique, thin, with no varix, the peristome incomplete. Dimensions not exactly measured, but the largest mature specimen has a maximum diameter of not more than .5 mm.

Habitat: Abundant in various locations in rock pools and in shallow water, mainly living on algae. The type was abundant on the green weed, *Ulva*, at Castle Rock, Middle Harbour, Port Jackson; we also have it from Long Reef, both on seaweed and beneath stones, also on the surface of a sponge from 10 feet, North Harbour, and in mussel beds within the harbour, and from Port Stephens in the north to Crookhaven Heads in the south.

Remarks: Of the three species described in this paper this is the smallest and the deepest in colour, and where they occur together it can readily be separated beneath the microscope by these means. Close examination will reveal other differences as shown in the figures.

Helisalia pallida, sp. nov. Figs. 46, 46a.

Shell minute, but the largest of those here described, nearly white, thin and translucent, discoidal and partially involute, coiled not quite in one plane, so that the spire is about level with the body whorl and less concave than the base. Protoconch partially infolded and details unobservable. Mature whorls three, rounded, sutures impressed. Sculpture confined to faint growth lines. Aperture large and rounded, the inner margin flattened, peristome incomplete. Umbilicus narrower and deeper than in *H. liliputia*. Maximum diameter .9 mm., minimum diameter about .75 mm.

Habitat: Abundant living on algae in rock pools and below low tide, both within the harbours and on the outside reefs. The type is from seaweed at Long Reef, but we also have it from numerous other localities.

Remarks: The larger size, the pale colour, and the different contour easily separate this from the other species described. It is from this species that a partially observed operculum appears to be white and thick, but full details could not be ascertained.

Helisalia sucina sp. nov. Figs. 47, 47a.

Shell minute, amber coloured, disc-shaped, very flat, the spire depressed below the body whorl, partially involute, coiled almost in the same plane, so that there is very little difference in appearance between the top and the base of the shell, shell thin and translucent. Protoconch partially infolded and the details unobservable. Mature whorls four, rounded, sutures impressed. Sculpture confined to faint growth lines. Base shallowly concave, the concavity so wide as to hardly constitute an umbilicus, the early whorls all visible from beneath. Aperture round, margins thin, peristome incomplete. Maximum diameter .7 mm., minimum diameter about .6 mm.

Habitat: Living on algae in rock pools, North Harbour.

Remarks: Compared with the other two species here described this is intermediate in size and colour, by which characters it can easily be separated under the microscope. It is also much flatter.

Genus MICROCARINA, gen. nov.

Genotype: *Microcarina surgerea* Laseron.

A minute genus of shells living on algae in shallow water, disc-shaped, flat above and widely umbilicate below, a sharp keel at the summit of the whorl and another at the periphery, no transverse sculpture, the peristome complete, the aperture very slightly oblique, the aperture polygonal, becoming rounded in fully mature specimens, thickened slightly, but without a varix. Shell substance thin, translucent.

The relationship is uncertain, the minute disc-like shell suggesting affinities with *Orbitestella*, generally included in a family of its own, Orbitestellidae, but the complete peristome suggesting the Liotiidae.

Microcarina surgerea, sp. nov. Figs. 42, 42a, 42b.

Shell minute, colourless and translucent, flat and disc-like, flattened above, the spire just visible when laterally viewed, the top of the aperture just below the body whorl. Protoconch naticoid, slightly tilted and partially submerged. Mature whorls three, rounded above with impressed sutures, a sharp keel on the summit, and another extending beyond this on the periphery, the space between slightly concave, smooth except for very faint growth lines. A third keel surrounds the umbilical region, and this again is separated from the peripheral keel by a slightly concave area.

Aperture large, polygonal in immature specimens, but becoming rounded with maturity, the peristome complete, and separate from the body whorl, umbilicus wide and deep. Maximum diameter 1 mm., minimum diameter slightly less.

Habitat: The type was alive on algae in rock pools in North Harbour. It is quite common, and we have it from similar locations both inside the harbour and on the outside reefs; also beneath stones and in beds of the common mussel, and from shell sand on Manly Beach and in Pittwater.

Remarks: There is no other species on the coast with which this can readily be compared, and its distinctive characters should make it easy of recognition. One character of distinct use when drawing is that it stands readily on its edge on a smooth surface when manipulated with a needle beneath the microscope.

Genus ORBITESTELLA Iredale.

Proc. Malacological Soc., xii, 1917, p. 327.

Genotype: *Cyclostrema bastowi* Gatliff.

In addition to proposing a new generic name, Iredale proposed a new family Orbitestellidae for this shell. His generic description reads: "Shell thin, pellucid, discoidal, dextral, of few whorls and of peculiar sculpture, widely umbilicate, columella vertical, aperture never variced, irregular in shape, edges thin." Augmenting this from the figure of the genotype, the peristome is incomplete, and the sculpture consists of a double keel, with transverse ribs radiating both on the summit and base of the shell, and the shell is minute.

The genotype is a Victorian shell, and though it is listed as from New South Wales I can find no record of its actual occurrence on this coast. Its record, therefore, should not be confirmed unless further evidence is brought to light. There are two undescribed species from the neighbourhood of Sydney which approximate to the generic characters of *Orbitestella*, and for the time being at least they may be left under that generic name.

Orbitestella decorata, sp. nov. Figs. 43, 43a, 43b.

Shell minute, white, translucent, discoidal, the summit flat, spire depressed below the body whorl. Details of protoconch unobservable. Mature whorls three, a prominent rounded keel on the periphery, indented by irregular tubercles, above this a flat step, and above this again the surface rounded to a deep suture, this portion showing from above strong transverse costae, radiating from the suture. A second keel is at the base of the body whorl, separated from the stronger peripheral keel by a slightly concave area, the base itself with transverse costae radiating from the umbilicus. Umbilicus wide, showing the earlier whorls. Aperture with incomplete peristome, polygonal, its posterior margin just below the level of the body whorl, without a varix. Maximum diameter .7 mm., minimum diameter about .6 mm.

Habitat: Living on algae, rock pools, North Harbour, not common (type); also under stones from the same locality.

Remarks: This among local species is nearest to the genotype, *C. bastowi*, and it is possibly the one that has appeared on the New South Wales list as that species. It differs, however, by the shape of the aperture, in the disposition of the keels, and in detail of the sculpture. It is a beautiful and distinctive little shell, whose further recognition should present little difficulty.

Orbitestella aura, sp. nov. Figs. 44, 44a, 44b.

Shell minute, bright golden in colour, discoidal and very flat, involute, coiled practically in one plane, in appearance very little different when viewed from above or below. Protoconch naticoid, slightly tilted and partially immersed, smooth. Mature whorls three, flattened and smooth at the periphery, sharp narrow keels above and below, beyond which are distinct narrow grooves. Upper portion of body whorl slightly rounded to rather shallow sutures, and bearing irregular transverse costae, which radiate from the suture. Sculpture on the base similar, the umbilicus so wide as to be only slightly more concave than the summit of the shell. Aperture produced, almost symmetrical with the body whorl, polygonal, but becoming rounded in fully

mature specimens, the peristome incomplete. Maximum diameter .9 mm., minimum diameter about .75 mm.

Localities: Manly Ocean Beach (type); collected by Mr. T. Iredale; also alive under stones in rock pool, Long Reef.

Remarks: This very distinctive little shell is doubtfully referred to as *Orbitestella*, as the ammonite-like coiling gives it a distinct facies, yet its characters as defined fit sufficiently to justify its inclusion. Except for the incomplete peristome it is almost identical with a small New Zealand shell, *Zerotula ammonitoides* Powell, which the author places among the Architectonidae. The protoconch of *C. aura*, though tilted and partially immersed, does not appear sinistral, as in *Heliacus* and others in the family.

Genus *PARISANDA*, gen. nov.

Genotype *Parisanda iredalei* Laseron.

A small genus of uncertain relationship, with a depressed turbinate shell, solid, porcellanous in texture, surface polished with variegated colouring, base with fine radiating plications which do not reach the narrow umbilicus, aperture oblique, peristome complete.

This is another peculiar little New South Wales shell whose characters will not fit any known genus. The general form and texture fit the small Queensland shell *Isanda coronata* A. Adams, which has the same radiating plications on the base even more strongly marked, but *Isanda* has an incomplete peristome. The form is again almost identical with *Cirsonella australis* Brazier, which lacks the basal plications, and again has a thin, glassy and not porcellanous shell. The texture and colouring are very like the smaller species of *Phasianella*, which, however, are not umbilicate, and have incomplete peristomes. Some features again recall the Trochidae. The operculum when found may give some clue to relationship, but for the present its systematic position must be left in abeyance.

Parisanda iredalei, sp. nov. Figs. 49, 49a.

Shell small, solid, turbinate, texture porcellanous and polished, apical whorls and area surrounding the umbilicus white, body whorl pale brown with transverse streaks of deep red brown. Protoconch naticoid. Mature whorls three, rounded, sutures deep. Aperture rounded, but slightly angled posteriorly, oblique, the peristome complete and removed from the body whorl by a channel. The base of the body whorl is finely plicate, the plications surrounding but not reaching the umbilicus, and fading towards the periphery. Umbilicus narrow, round and deep. Diameter of base 1.7 mm., height about 1.5 mm.

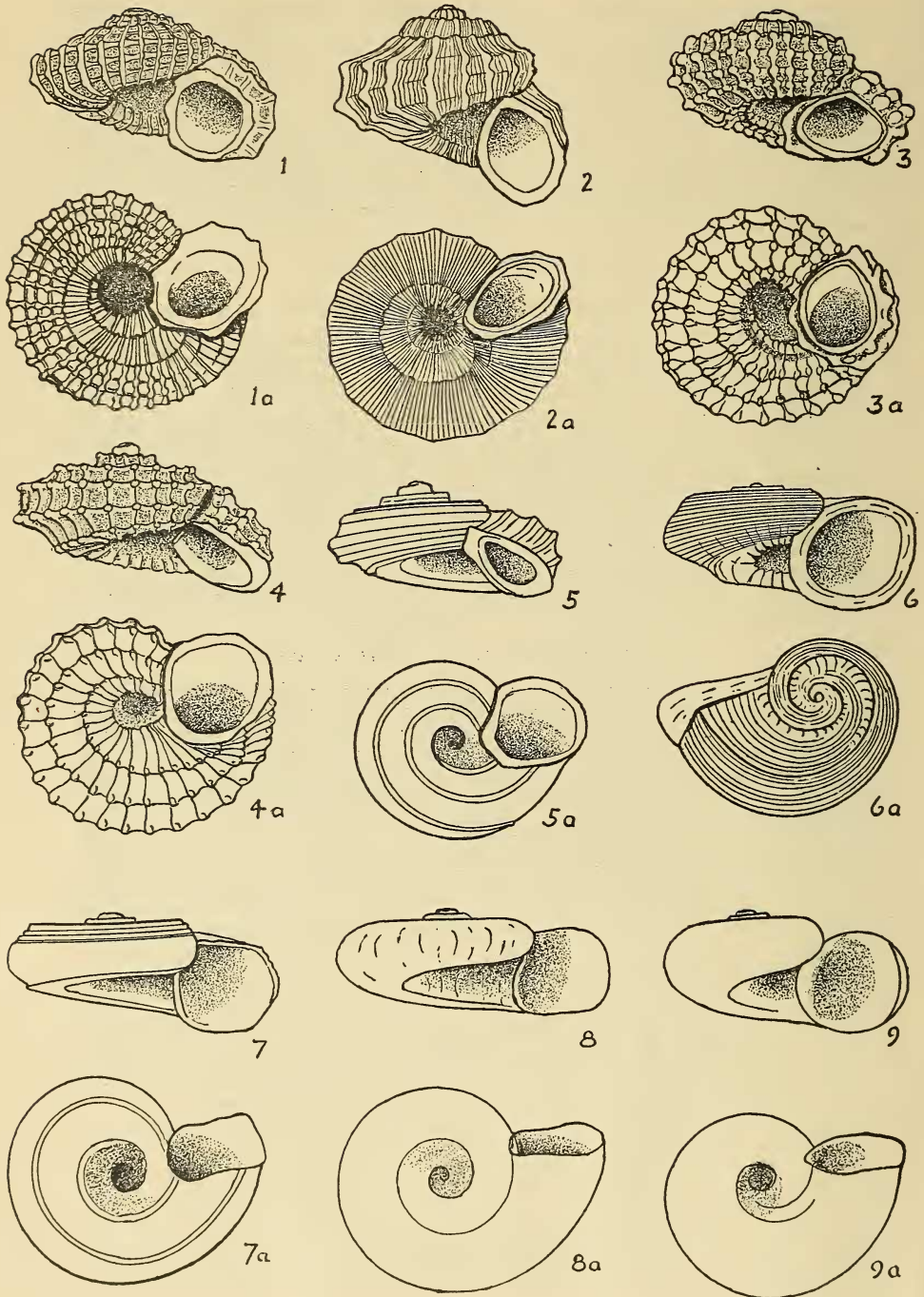
Locality: Manly Ocean Beach; collected by Mr. Tom Iredale.

Remarks: For this striking little novelty I am indebted by Mr. Tom Iredale, who generously handed it to me for description. There is no other local species with which it can be compared, and its possible generic relationships have already been discussed.

"*Liotia alazon* Hedley," Rec. Austr. Mus. vi, 1905, p. 49, fig. 14.

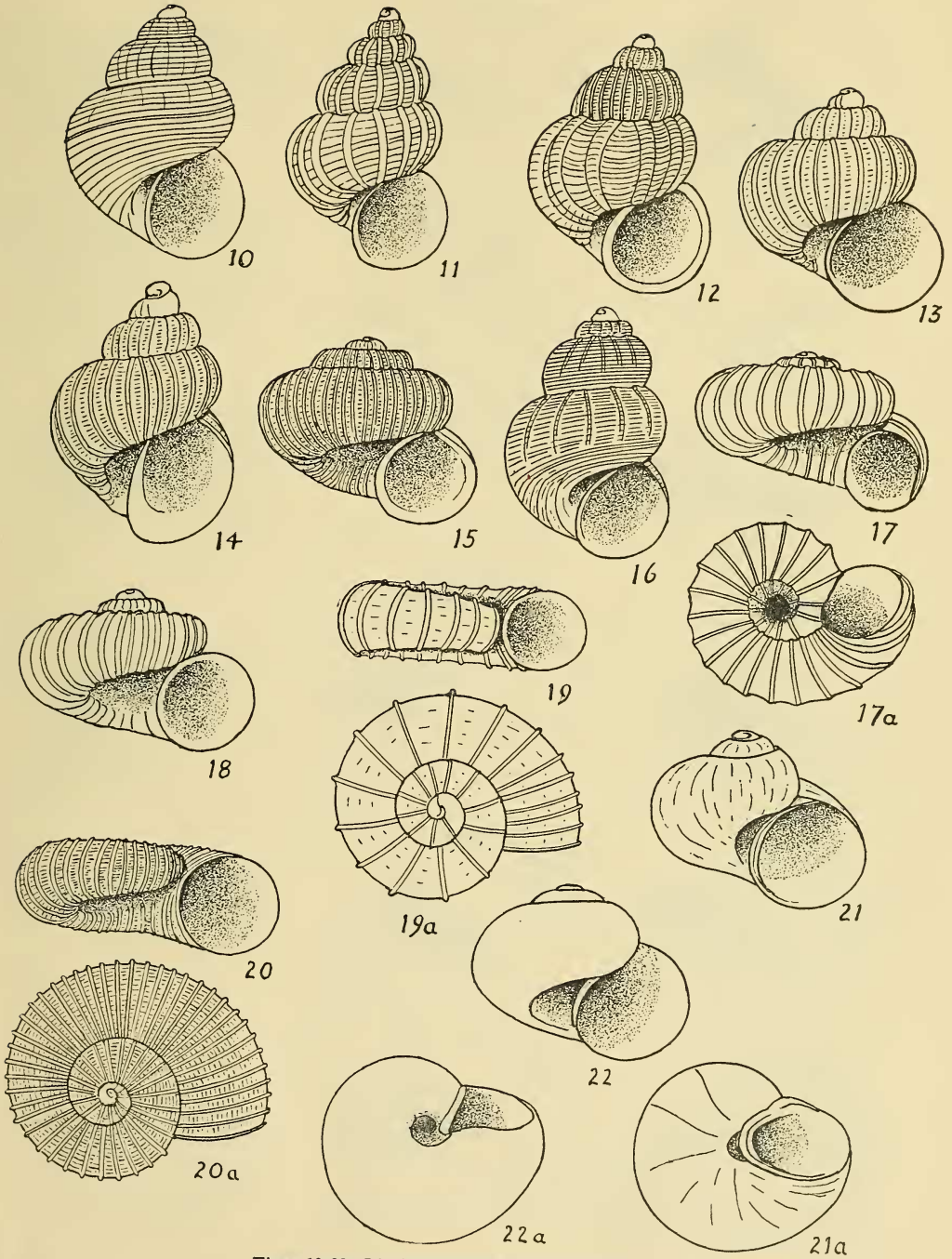
This is a minute shell from deep water, 111 fathoms, at 12½ miles east of Cape Byron, and is doubtfully related to the Liotiidae at all.

New generic names proposed above—*Callodix*, *Cavostella*, *Cavotera*, *Conicella*, *Helisalia*, *Liocarina*, *Microcarina*, *Parisanda*, *Rotostoma*, and *Wanganella*.



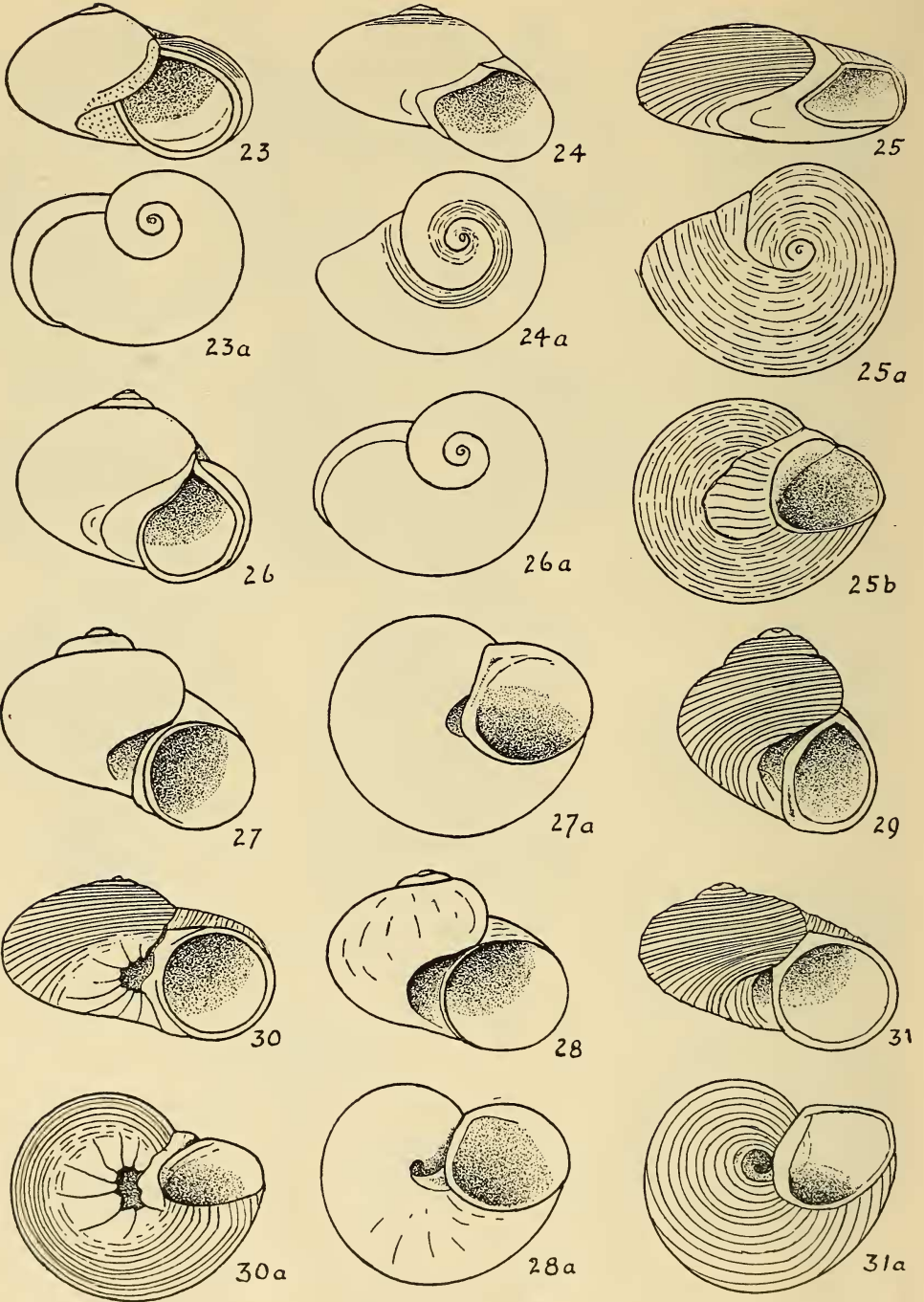
Figs. 1-9: Liotiidae of New South Wales.
 (For explanation of figures see page 25)

C. F. Laseon del.



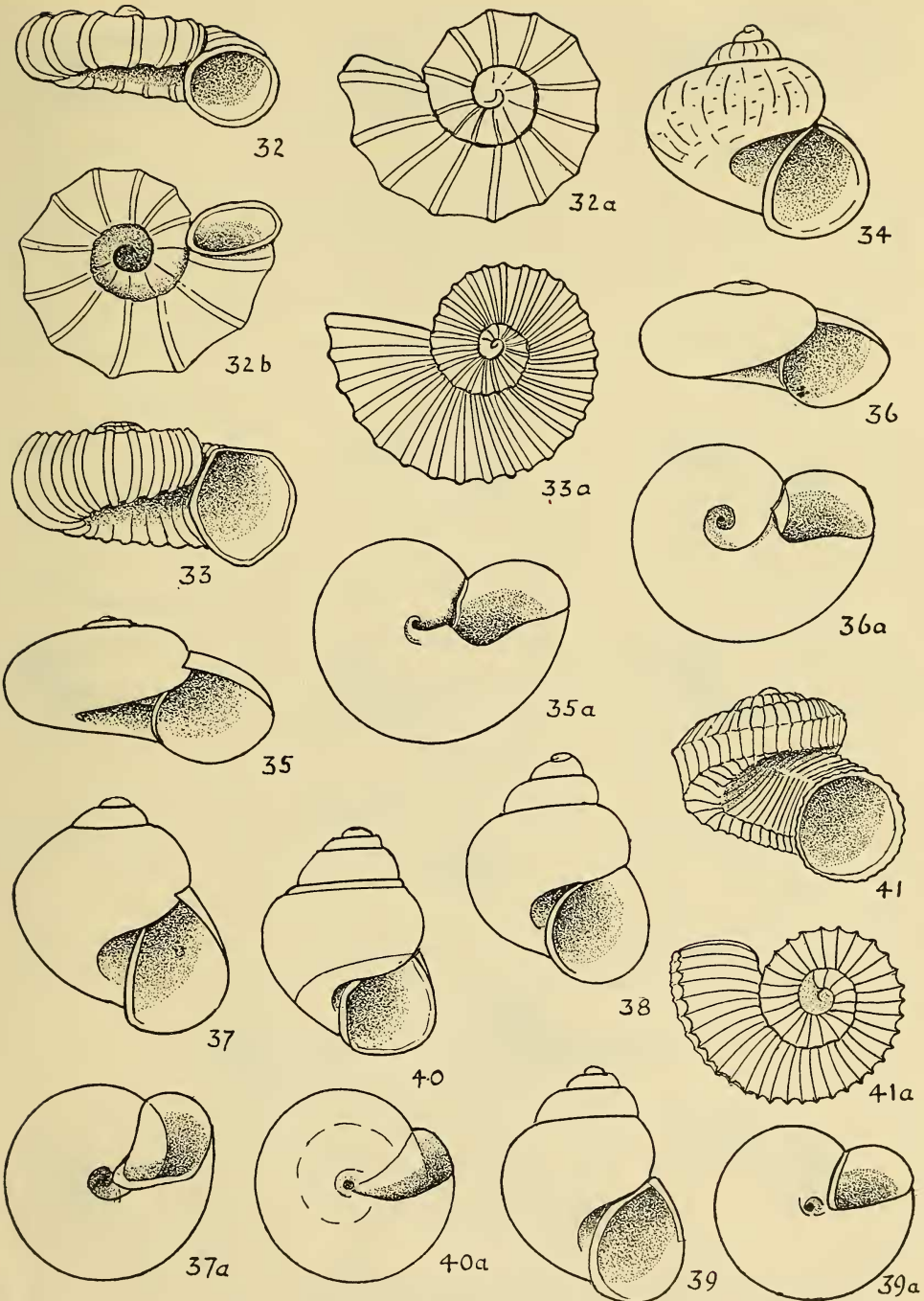
Figs. 10-22: Liotiidae of New South Wales.

C. F. Laseron del.



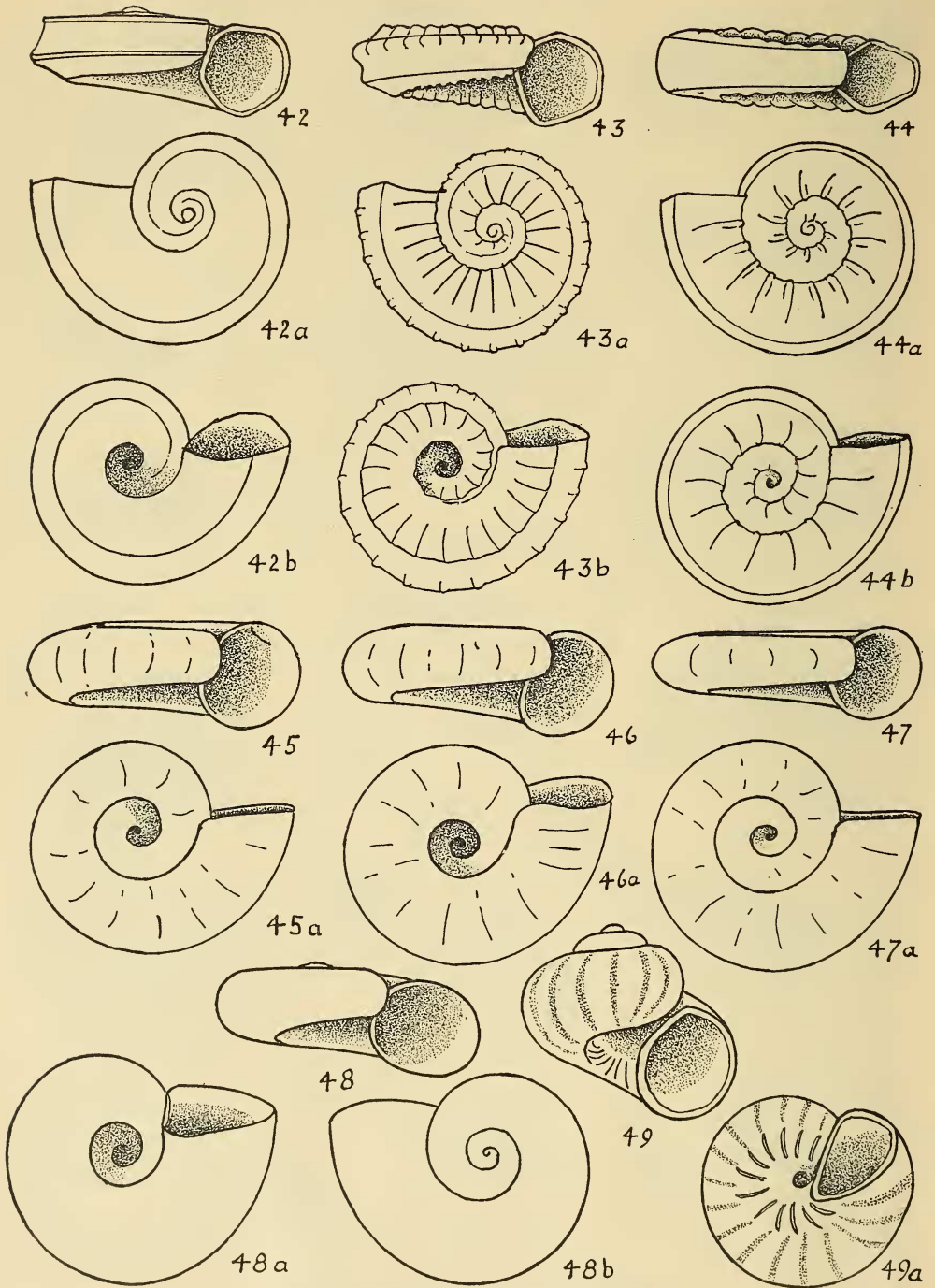
Figs. 23-31: Liotiidae of New South Wales.

C. F. Laseron del.



Figs. 32-41: Liotiidae of New South Wales.

C. F. Laseron del.



Figs. 42-49: Liotiidae of New South Wales.

C. F. Laseron del.

EXPLANATION OF FIGURES.

Figs.

- 1, 1a.—*Liotina botanica* Hedley.
 2, 2a.— *saxa* Laseron.
 3, 3a.—*Pseudoliotia micans* Adams.
 4, 4a.— *speciosa* Angas.
 5, 5a.—*Lodderia lodderae* Petterd.
 6, 6a.—*Lodderena minima* Ten. Woods.
 7, 7a.—*Partubiola blancha* Iredale.
 8, 8a.—*Microdiscula vitrea* Laseron.
 9, 9a.— *pellucida* Laseron.
 10.—*Brookula obscura* Laseron.
 11.— *jacksonensis* Laseron.
 12.— *augeria* Laseron.
 13.— *turbinata* Laseron.
 14.— *orospatia* Laseron.
 15.— *finesia* Laseron.
 16.— *tumida* Laseron.
 17, 17a.—*Liotella princeps* Laseron.
 18.— *littoralis* Laseron.
 19, 19a.— *parvirota* Laseron.
 20, 20a.— *pulcherrima* Brazier.
 21, 21a.—*Cirsonella perplexa* Laseron.
 22, 22a.—*Lissotesta arenosa* Laseron.
 23, 23a.—*Callomphala lucida* Adams & Angas.
 24, 24a.—*Rotostoma brazieri* Angas.
 25, 25a, 25b.—*Callodix solida* Laseron.
 26, 26a.—*Callomphala alta* Laseron.
 27, 27a.—*Cirsonella australis* Angas.
 28, 28a.— *reflecta* Laseron.
 29. —*Charisma compacta* Hedley.
 30, 30a.—*Cavostella radians* Laseron.
 31, 31a.—*Cavotera simplex* Laseron.
 32, 32a, 32b.—*Liotella patonga* Laseron.
 33, 33a.— *gravicosta* Laseron.
 34.— *Brookula* sp.
 35, 35a.— *Starkeyna starkeyae* Hedley (after Hedley).
 36, 36a.— *Lissotesta inscripta* Tate (after Hedley).
 37, 37a.— *Conicella lata* Laseron.
 38.— *porcellana* Tate & May.
 39, 39a.— *lacuna* Laseron.
 40, 40a.— *Wanganella fissura* Laseron.
 41, 41a.— *Liocarina disjuncta* Hedley (after Hedley).
 42, 42a, 42b.—*Microcarina surgerea* Laseron.
 43, 43a, 43b.—*Orbitestella decorata* Laseron.
 44, 44a, 44b.— *aura* Laseron.
 45, 45a.— *Helisalia liliputia* Laseron.
 46, 46a.— *pallida* Laseron.
 47, 47a.— *sucina* Laseron.
 48, 48a, 48b.—*Microdiscula fragilis* Laseron.
 49, 49a.— *Parisanda iredalei* Laseron.

(Unfigured: *Liotina scalaris* Hedley, *Liotella capitata* Hedley.)